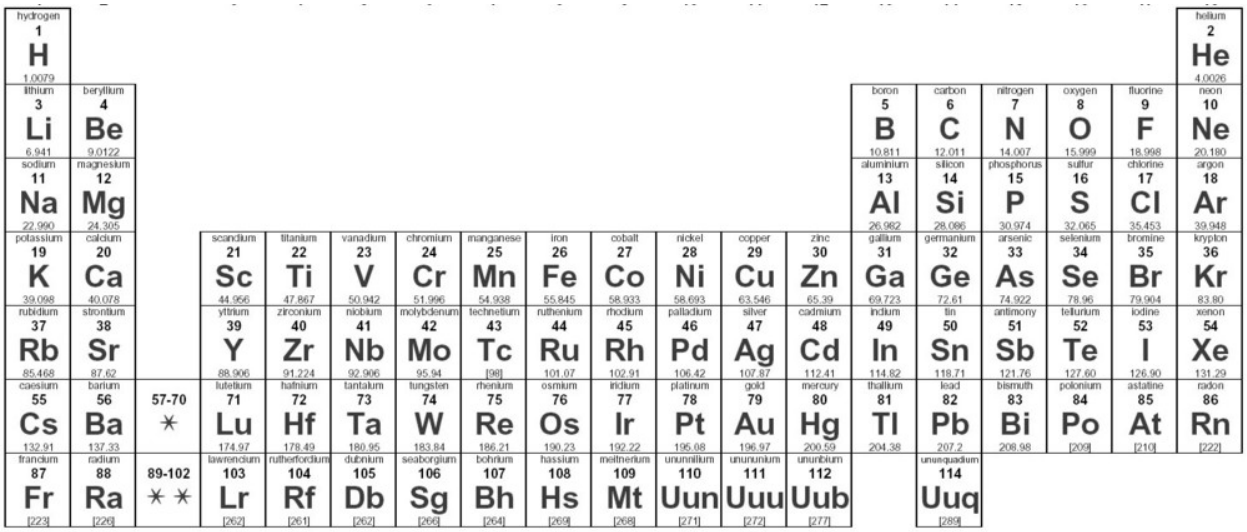
BCH2333A **Midterm 1 2015**

NAME_____KEY_____

Student number_____



Multiple choice questions. ***Note there may be more than 1 correct answer. Select all that are correct.***

1. What is the pH of an aqueous solution with $[OH^-] = 5 \times 10^{-12}$ M?

a. -11.3

b. 5

c. 11.3

d. 2.7

2. At pH 10 what will the ratio of ammonium to ammonia be? The pKa of ammonium is 9.24.

a. 5.7

b. 0.76

c. 0.17

d. 1.3

3. What non-covalent force can occur between the *side chains* of Met and L?

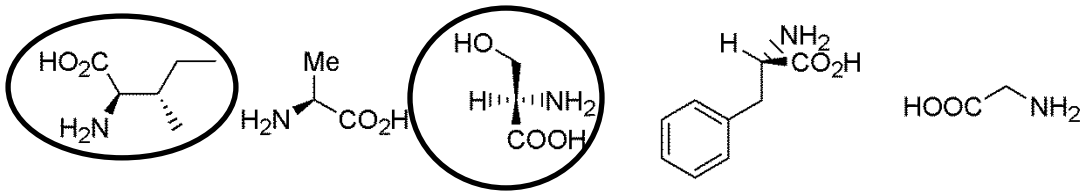
a. electrostatic interactions

b. hydrogen bonds

c. London Forces

d. dipole-ion interactions

4. Circle the amino acids that are in the D-configuration.



5. What is the K_{eq} for this reaction $H_2CO_3 + Et_3N \rightleftharpoons HCO_3^{\ominus} + Et_3NH^{\oplus}$?

$$= \frac{[HCO_3^{\ominus}]+[Et_3NH^{\oplus}]}{[H_2CO_3][Et_3N]} \qquad = \frac{[H_2CO_3][Et_3N]}{[HCO_3^{\ominus}][Et_3NH^{\oplus}]} \qquad = \frac{[HCO_3^{\ominus}][Et_3NH^{\oplus}]}{[H_2CO_3][Et_3N]} \qquad = k_1[H_2CO_3][Et_3N]$$

6. What is the net charge for the peptide PQPQLPY at pH 12?

a. +2

b. +1

c. 0

d. -1

e. -2

7. What is the net charge of the tetrapeptide Ala-His-Cys-Ser at pH 5?

a. +2

b. +1

c. 0

d. -1

e. -2

8. Which two amino acids have amides in their side chains?

a. serine and Thr

b. F and Trp

c. Arginine and Gln

d. Q and Asparagine

9. Which bases pair together in DNA?

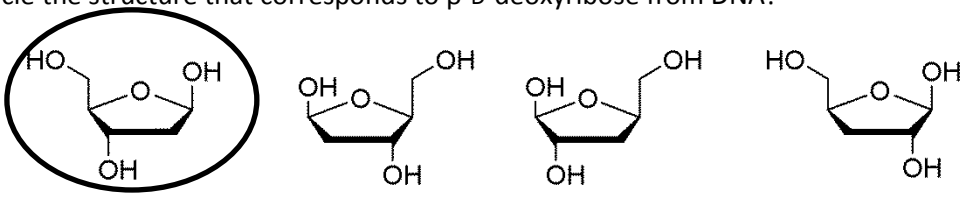
a. Guanine and cysteine

b. Adenine and uracil

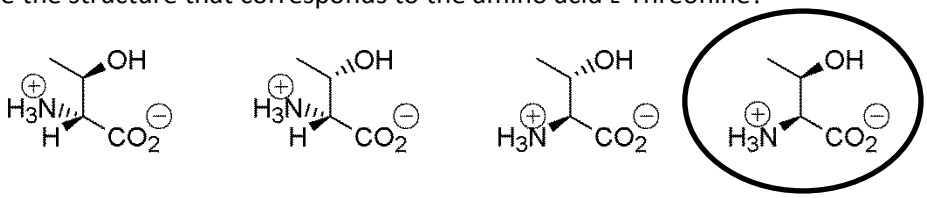
c. Guanine and adenine

d. cytosine and Guanine

10. Circle the structure that corresponds to β-D-deoxyribose from DNA?



11. Circle the structure that corresponds to the amino acid L-Threonine?



12. What is the side chain pKa for Arg?

a. 4.0

b. 6.0

c. 8.4

d. 10.5

e. 12.5

13. What is the pKa of the carboxylic acid of Tryptophan?

a. -2

b. 0

c. 2

d. 4

e. 5

14. What is the charge on the peptide ACE at pH 9.0?

a. +2

b. +1

c. 0

d. -1

e. -2

15. What is the charge on the peptide CLD at pH 7.0?

a. +2

b. +1

c. 0

d. -1

e. -2

16. What is the charge on the peptide WEC at pH 1.0?

a. +2

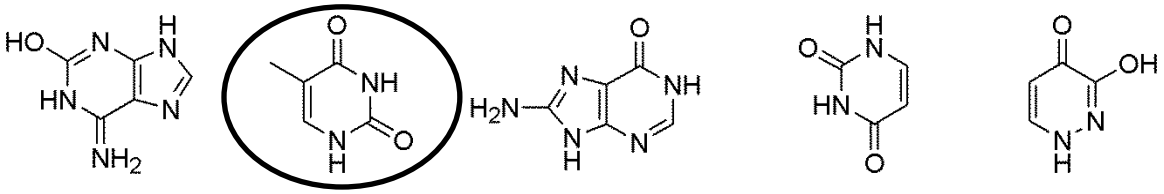
b. +1

c. 0

d. -1

e. -2

17. Circle the aromatics that are bases normally found in DNA?



18. For all spontaneous reactions:

a. ΔH and ΔS must be positive

b. ΔH must be negative and ΔS must be positive

c. ΔH and T*ΔS must be opposite in sign

d. ΔG must be positive

e. ΔG must be negative

19. What non-covalent forces are involved in water solvating the side chain of tryptophan.

a. dipole-ion interactions

b. electrostatic interactions

c. hydrogen bonding

d. London forces

20. In the "RNA World" hypothesis:

a. RNA is thought to have evolved from DNA.

b. The three amino acid R, N and A were formed chemically in a primordial soup.

c. DNA and proteins evolved from self-replicating RNA systems.

d. life was thought to evolve 6 billion years ago.

Short answer questions

21. You have a 1M solution of acetic acid, a 1M solution of sodium acetate, and pure water. You need to make1 L of a 0.1M acetate buffer solution at pH 4.5. The pKa of acetic acid is 4.76. How much of each 1M solution and water do you need to add together to make your buffer.

4.5=4.76 + log ([A-]/[HA])

-0.26 = log ([A-]/[HA])

[A-]/[HA] = 0.55

[A-] + [HA] = 0.1M

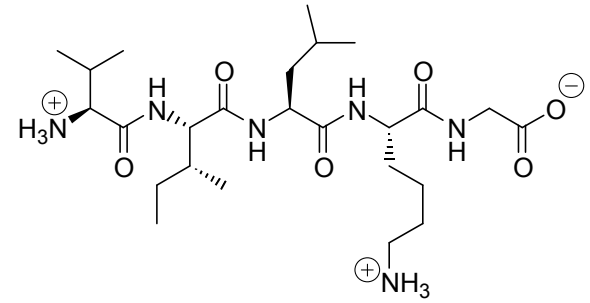
1.55[HA] = 0.1M

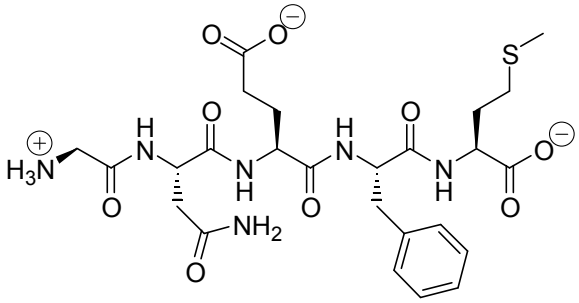
[HA] = 0.065M, [A-] = 0.035M

Add 65 mL of 1 M Acetic acid and 35 mL of 1M sodium acetate then add water to bring to 1 L.

22. Two proteins interact. A biochemist has identified a short polypeptide from each protein that is responsible for much of the protein-protein interaction. The two peptides are VILKG and GNEFM.

A) Draw the structures of the two peptides, VILKG and GNEFM, at pH 7.4.





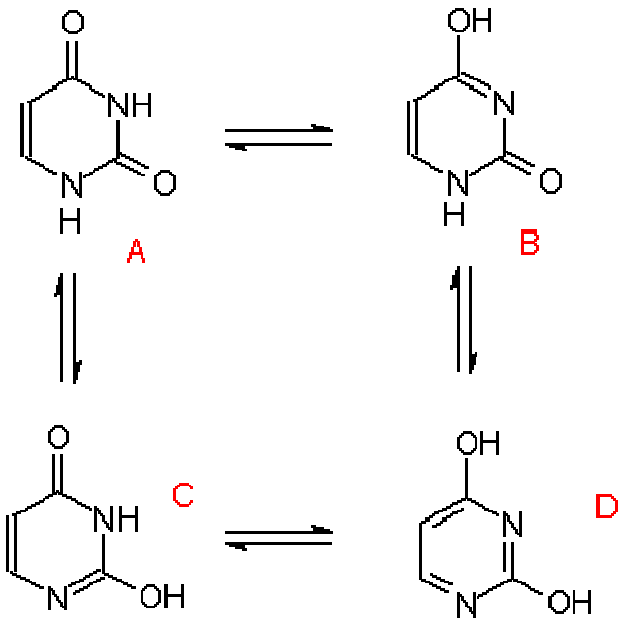
B. There is a strong non-covalent interaction between the side chains of two amino acid residues, one from each of these polypeptides. Which two residues interact (give their 3 letter codes) and what type of non-covalent interaction can occur between them?

Lys, Glu, ionic interaction

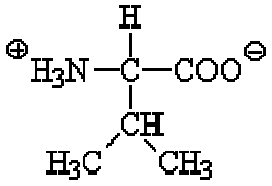
C. This protein-protein interface excludes water. Does this increase or decrease the strength of the non-covalent bond between these two peptides?

Increases

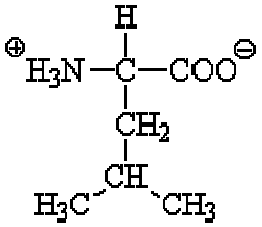
23. Draw four uracil tautomers.



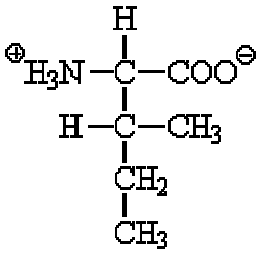
24. Show the structure of 3 β-branched amino acids.



Valine (Val)



Leucine (Leu)



Isoleucine (Ile)